Commentary

**The House Cricket is an unrecognized but potentially powerful model for aging intervention studies.**

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**Abstract.**

Human-based research in biology of aging poses challenges due to ethical, social, and cost considerations. Animal models offer a pragmatic alternative, though no single model fully replicates all aspects of human aging. One unexplored model for studying aging is the house cricket (*Acheta domesticus*). House crickets present advantages for aging intervention research such as consuming an omnivorous diet, availability on a heterogeneous genetic background, short lifespan, and simple but well-defined organ systems. A preliminary experiment investigated the effects of flax oil, rich in omega-3 fatty acids, on the lifespan of house crickets. Cold pressed flax oil was added to moistened guinea pig chow mash as a 10% mixture and fed to crickets starting at 8 weeks of age and continuing for 11 weeks when the last cricket died. Results demonstrated a significant extension in survival for crickets fed the flax oil diet, further emphasizing the low cost, simplicity, and short time required for conducting dietary intervention studies in house crickets. Using this observation as a prototype, the house cricket is a promising and deserving model for intervention drug testing based on an aging platform.

**Key words:** Aging, House cricket, Lifespan, Aging intervention, Flax oil

Aging is a complex process characterized by functional decline and increasing morbidity, and stands as a predominant risk factor for numerous diseases. Therefore, a better understanding of the underlying mechanisms associated with aging may facilitate the development of new treatments [1]. The complexities of human-based research, including ethical, social, and cost considerations, coupled with a long lifespan, pose significant challenges. Consequently, exploring aging through animal models emerges as a pragmatic alternative. While no single animal model can fully replicate all aspects of aging in humans, a comprehensive understanding of the characteristics of the specific model and a judicious interpretation of the results within its defined limits can facilitate focused investigations into critical facets of age-related diseases and their associated treatments [2].

The criteria for selecting effective animal models revolves largely around translational value to humans in terms of physiological and/or pathological aspects [3]. Rodents, non-human primates, flies, (*Drosophila melanogaster)*, and worms (*Caenorhabditis elegans*) have been used extensively in aging research [4]. Recognizing the challenges associated with vertebrate models, including long lifespan, size, ethical constraints, and expense [5-6], underscores the importance of integrating translational invertebrate models, particularly in lifespan studies. A significant amount of new knowledge has been generated with these models on aging and age-related diseases.

Mammalian models of aging have some of the same constraints as humans, while flies and worms have technical constraints. Flies are holometabolous (i.e., multiple developmental life stages) and most studies are restricted to only the adult stage [5] while worms feed on bacteria and lack a vascular system along with organs that target it (i.e., brain, heart, kidney) [7]. As a result, test materials and accurate dosing are technically demanding. *Acheta domesticus*, or more commonly known as the “house cricket,” stands as a promising model for the study of aging and age-related diseases for several reasons. 1) They are omnivorous with rudimentary but well-defined organ systems (Figure 1); 2) They are relatively easy to rear at 30-32 degrees centigrade in large quantities, small area, and low cost [8-10]; 3) Crickets are hemimetabolous with an average 4-month lifespan where young share the same diet as adults; 4) Crickets have visually distinguishable sexual maturation between developmental stages and adults [9-11]; 5) Neurogenesis occurs in the cricket brain in an area analogous to the mammalian hippocampus [12-14]; 6) Cognitive and non-cognitive behavioral tests can easily be performed in crickets [15].



**Figure 1**. Internal structures of the domestic house cricket.

Given these characteristics, house crickets are therefore ideal for aging studies. As an example, extended lifespan was seen by our lab when crickets were fed flax oil added to their diet. Genetically heterogenous house crickets were obtained from Fluker Farms (Louisiana) at 8 weeks of age and fed guinea pig chow or guinea chow with 10 percent cold-pressed flax oil (Barlean’s). They were housed in a transparent and aerated plastic box (36 x 36 x 20 cm) containing an egg carton shelter, a tray with a moistened sponge, and a food tray at an environmental temperature of 20-21 degrees centigrade and a 12 h on/12 h off light cycle. The guinea pig chow contained protein 16%, fat 3.5%, fiber 12.5%, ash 6%, calcium 0.8%, phosphorus 0.6%, copper sulfate 15 mg/kg, vitamin A 6000 IU/kg, vitamin C 300 mg/kg, vitamin D3 520 IU/kg, vitamin E 24 IU/kg and was prepared as a mash with 30 gm of chow and 300 ml of sterilized distilled water, providing a consistency readily ingested by the crickets.

Crickets fed guinea chow with flax oil had a significant increase in lifespan compared to crickets fed just guinea pig chow (Figure 2). The 50 percent survival rate was 82 and 94 days, respectively and the 10 percent survival rate was 109 and 136 days, respectively. Flax oil is rich in polyunsaturated omega-3 fatty acids (PUFA), particularly alpha-linolenic acid, which has been shown to exhibit anti-inflammatory and antioxidant effects [16]. Crickets have a simplified gut structure consisting of a single layer of epithelium with various cells such as enterocytes responsible for nutrient absorption [17], including dietary lipids such as PUFAs [18]. While the effects of PUFAs are not well-documented in the insect digestive system, they are known to improve the integrity of the intestinal epithelial barrier in mammals by preventing changes to epithelial permeability, inhibiting production of pro-inflammatory molecules, and enhancing the production of anti-inflammatory molecules [19-21].



**Figure 2.** Starting at 8 weeks of age, house crickets were fed guinea pig chow with 10 percent flax oil versus crickets fed just guinea pig chow. Lifespan in the two cohorts was assessed using Kaplan-Meier (log-rank) survival analysis. Time points were assigned equal weights using a Mantel-cox test. p < 0.05. N= 29-30 per cohort.

The optimal advantages of crickets as an animal model for aging, plus our preliminary observations, provide a strong rationale to conduct more in-depth studies using house crickets for testing a variety of intervention strategies with lifespan as well as cross-sectional approaches.

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